COPY FOR OFFICIAL USE.

120

M.O. 336a.

AIR MINISTRY

METEOROLOGICAL OFFICE

PROFESSIONAL NOTES No. 61

(*First Number of Volume V*)

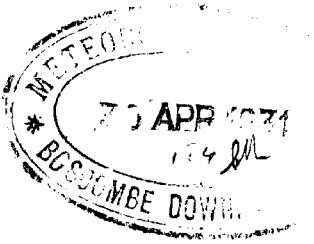
A COMPARISON OF TEMPERATURES INSIDE AND OUTSIDE THE METEOROLOGICAL ENCLOSURE

at the Airship Base, Ismailia, Egypt

J. DURWARD, M.A.

Published by the Authority of the Meteorological Committee

Crown Copyright Reserved

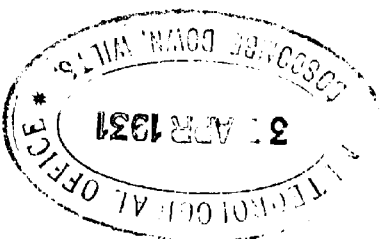


LONDON:
PRINTED AND PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses:
Adastral House, Kingsway, London, W.C.2; 120, George Street, Edinburgh;
York Street, Manchester; 1, St. Andrew's Crescent, Cardiff;
15, Donegall Square West. Belfast;
or through any Bookseller.

1931

Price 2*d*. Net.

40–57–61



A COMPARISON OF TEMPERATURES INSIDE AND OUTSIDE THE METEOROLOGICAL ENCLOSURE AT THE AIRSHIP BASE, ISMAILIA, EGYPT

By J. DURWARD, M.A.

General.—Owing to the shifting nature of the sand in the vicinity of the meteorological office at Ismailia, it is necessary to have some sort of protection around the instrument enclosure in addition to the usual wire fence. Sudanese matting, 4 feet high, has therefore been erected on each side of the enclosure except the south, where such protection is not required.

It was realised that the temperatures in the thermometer screen inside the enclosure might be affected by this matting especially during the hot weather and during calm days, but as the thermometer bulbs were slightly above the level of the top of the matting, it was hoped that such effect would be small. In order to test the point a second screen was erected outside the enclosure and a series of comparative readings instituted. They showed that the effect of the matting was very much greater than was anticipated, and a note on the differences of temperature observed under varying conditions may be of interest.

Lay-out.—The thermometers were exposed in large-sized Stevenson screens. The screen A inside the enclosure was about 10 feet from the north and east sides of the enclosure ; the outside screen B was about 12 yards away in a south-easterly direction (*see* Fig. 1).

Originally the bulbs of the thermometers in screen A were 2 inches above the level of the top of the matting ; this difference in level was subsequently increased to 1 foot 2 inches by raising the height of the thermometer screen by 1 foot ; it was further increased in a third set of comparisons to approximately 2 feet by removing the top 10 inches of matting. In all observations the thermometers in screen B were 4 feet 2 inches above the ground ; those in screen A were 4 feet 2 inches above ground in Series 1, and 5 feet 2 inches in Series 2 and 3.

Results.—The following table shows the average differences of temperature in ° F. observed between screens A and B at various hours and the average differences between the maximum and minimum thermometers exposed in screens A and B.

Series 1.—Thermometers in screen A, 2 inches above matting and 4 feet 2 inches above ground.

Series 2.—Thermometers in screen A, 1 foot 2 inches above matting and 5 feet 2 inches above ground.

Series 3.—Thermometers in screen A, 2 feet above matting and 5 feet 2 inches above ground.

Thermometers in screen B, 4 feet 2 inches above ground throughout.

To face p. 2

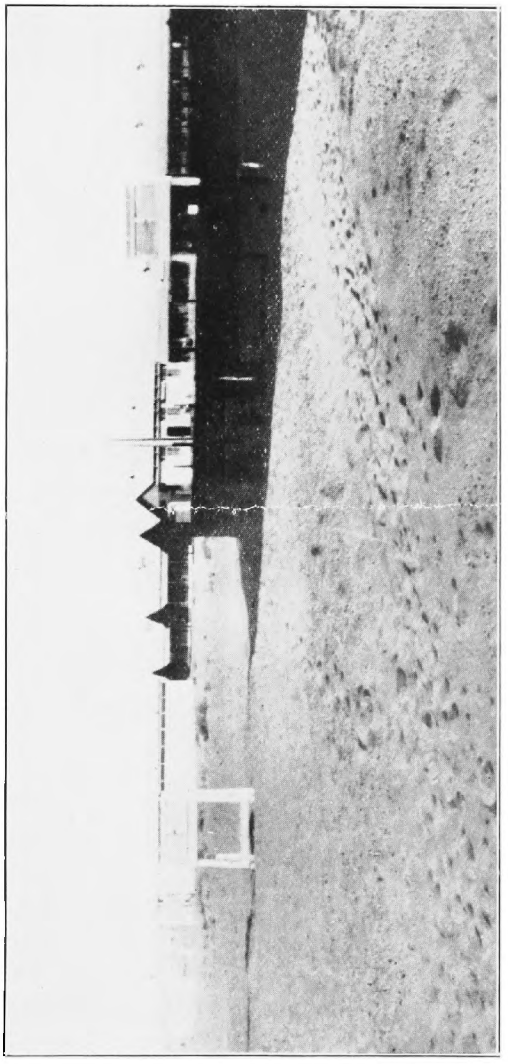


FIG. 1.—Screens A (inside enclosure) and B, looking south.

[*Photograph taken September*, 1929.]

Date.	4-5 a.m.	8 a.m.	11 a.m.	2 p.m.	8 p.m.	Max.	Min.
Series 1.	Difference (Screen A–Screen B).						
Aug., 1928	+ 0·2	+ 0·7	+ 2·1	+ 1·7	+ 0·2	+ 1·4	− 0·7
Sept., 1928	+ 0·2	+ 0·5	+ 2·7	+ 1·6	+ 0·2	+ 1·6	− 0·6
Nov., 1928	+ 0·1	− 0·2	+ 1·5	+ 2·0	− 0·1	—	− 0·5
Dec., 1928	0·0	− 0·3	+ 0·7	+ 1·3	0·0	+ 1·1	− 0·5
May, 1929	− 0·3	+ 0·8	+ 2·7	+ 2·2	—	+ 3·0	+ 0·2
Series 2.							
June, 1929	+ 0·2	+ 1·0	+ 1·2	+ 1·1	—	+ 1·5	+ 0·3
Series 3.							
July, 1929	+ 0·2	+ 0·5	+ 0·4	+ 0·7	0·0	+ 0·9	+ 0·6
Aug., 1929	+ 0·2	+ 0·4	+ 0·4	+ 0·6	—	+ 0·8	+ 0·5
Sept., 1929	+ 0·1	+ 0·2	+ 0·6	+ 0·3	—	+ 0·6	+ 0·7

Discussion.—Considering the first series of observations, when the bulbs of the thermometers in screen A were 2 inches above the level of the matting, it will be seen that the average differences of temperature during the period 4–5 a.m. and at 8 p.m. are very small and irregular. At 8 a.m. the differences are positive in summer and negative in winter. At 11 a.m. the average differences are positive and reach the large value of 2·7° F. in September and May. At 2 p.m. the differences are positive and slightly less than those at 11 a.m. The average maximum temperatures differ by as much as 3° in May and the minimum by about 0·6°, the minimum inside the enclosure being the lower. The largest difference of temperature recorded on an individual occasion was 6·4° at 11 a.m. on May 13, 1929, whilst the maxima have differed by as much as 6·2° F.

The raising of the thermometer screen A by 1 foot in June, 1929, effected a distinct improvement, the average differences of temperature at 11 a.m. and 2 p.m. being about half those found in May, 1929. The same applies to the maximum temperatures.

The removal of about 10 inches of matting in July, 1929, which brought the level of the bulbs in thermometer screen A about 2 feet above the matting caused a further improvement. The average temperature differences were reduced thereby to about 0·6° and 0·7° F. at 11 a.m. and 2 p.m. respectively and to about 0·9° in the readings of the maximum thermometers. This may be considered satisfactory as differences of this order have been observed in readings taken in thermometer screens exposed in different positions inside the same enclosure or in enclosures a short distance apart.

Thermometer readings inside the enclosure have thus been made comparable with those outside by increasing the distance

(4025) Wt. 23297/1146/2014 625 3/31 Harrow G.1/27

between the thermometer bulbs and the top of the matting from 2 inches to 2 feet The same result would probably have been secured by cutting away the bottom of the matting, but this would have completely defeated the purpose for which the matting was erected.

Presumably the differences between temperatures inside and outside the enclosures are due to the fact that the vertical interchange of air is not so efficient inside the enclosure as it is outside. Results of experiments show that—

(*a*) with an enclosure formed of matting 4 feet high temperatures at a height of 4 feet inside the enclosure are considerably higher than those at a height of 4 feet in the free air outside the enclosure,

(*b*) the differences between temperatures at a height of 5 feet inside the enclosure and at a height of 4 feet in the free air outside are about one-half of those found in (*a*) and

(*c*) if the height of the matting forming the enclosure is reduced to 3 feet the differences between the temperatures at a height of 5 feet inside the enclosure and at a height of 4 feet in the free air outside the enclosure are almost negligible. The height (5 feet) inside the enclosure in this case (matting 3 feet high) is probably equivalent to a height of 6 feet under the conditions in (*a*) and (*b*) (matting 4 feet high).

As the difference between the temperature at 4 feet and 6 feet above the ground in the free air is known to be very small[1] it follows that there is very little difference between temperatures at a height of about 6 feet both inside and outside the enclosure. Therefore the temperature gradient from about 4 feet to 6 feet over the enclosure sometimes reaches the very high value of 6° F. per 2 feet at 11 a.m. It might be assumed that with a temperature gradient like this, the vertical transfer of heat would have been very rapid, but as the large differences are persistent during the day, it follows that in the lowest layers of the atmosphere superadiabatic lapse-rates may be persistent if the atmosphere is not turbulent.

The non-turbulent conditions were secured in the present case by erecting matting on the windward side of the enclosure 30 feet square.

As the thermometers in Stevenson screens are not aspirated, it was considered possible that the temperature in the screen inside the enclosure might be that of an isolated mass of almost stagnant air artificially heated by the screen itself. Careful readings with Assmann thermometers were taken : that inside the enclosure being suspended on the screen with the bulbs of the

[1] Notes on the Mirage as observed in Egypt *Q. J. R. Meteor. Soc.* **47**, 1921, p. 17.

thermometers on a level with the top of the matting (i.e., about 3 feet above the ground) and the one outside the enclosure at the level of the thermometers in the outside screen (4 feet 2 inches). The mean of 50 simultaneous pairs of readings made at about 11 a.m. showed an average difference of 1·6° F., the maximum difference recorded being 3·9° F.

These Assmann readings are not strictly comparable with those taken before the top of the matting was removed, but as the average difference between temperatures at a height of 3 feet and 4 feet in the free air[2] is about 0·3° F., it appears that the matting has a considerable effect on the temperature inside the enclosure when the bulbs of the thermometers are exposed at a height of less than 2 feet above the top of the matting.

[2] loc. cit.